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DEPARTMENT OF COMMERCE

BUREAU OF STANDARDS

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1 Electroplating of Military Equipment. As a result of a conference on this subject, an experienced electroplater was engaged by the Bureau of Standards to serve as plating adviser to the military departments. Since then he has conferred extensively with military officials, manufacturers, and platers, and has thus obtained and furnished much valuable information. Investigations are in progress at the Bureau of Standards to determine the best methods of operation, control, and inspection of plating, a subject which has previously received very little consideration from the technical and scientific standpoint. In fact, plating as generally conducted has been purely an empirical operation. In connection with this work the Bureau is frequently called upon to plate by one or more processes, sample parts submitted by military officials, which are subsequently subjected to service tests, thus determining the kind of plating best adapted to the particular need. The Bureau's services are also requested in connection with the design of new plating plants or extensions to existing plants engaged in Government work. Among the subjects now receiving consideration are the following: (1) the possibility of relining guns by plating; (2) the production of heavy nickel deposits, as for example, for seamless tubes; (3) lead plating, with special reference to the plating of adapters, etc., and lining of gas shells; (4) methods of increasing the weight of under-weight shells, by plating the inside; (5) the operation and simplification of black nickel baths used to produce the "Government bronze" finish; (6) zinc plating vs. copper plating of steel cartridge cases, to replace brass cases; (7) plating of airplane fittings, especially zinc plating for parts of naval planes; (8) reproduction by electroplating of engraved scales, for example, master scales used in the production of range finder graduations; (9) the development of simple methods of analysis of plating solutions, applicable by the platers, or if necessary, by travelling inspectors; (10) extending the use of zinc plating so far as possible to all steel parts requiring protection against corrosion. The present use of copper for this purpose represents an unnecessary consumption of copper, and yields protection decidedly inferior to zinc; (11) the effect of pickling and plating operations upon the physical properties of steel, with special reference to avoiding embrittlement of springs by plating.

2 Cement and Concrete Materials. Investigation is being made of various types of commercial concrete hardeners. Severe grinding tests on slabs of concrete made of coarse sand and treated with various hardeners showed no advantage resulting from any of the treatments. Preparations are being made also to treat slabs of neat cement, which will be submitted to the same test. An abrasion apparatus is being constructed for the purpose of making extensive wear tests on various flooring materials which, of course, will also be available for future tests of concrete hardeners.

The study of materials for producing a light weight concrete has included the following materials: Haydite made from Missouri shale; Haydite made from Georgia shale and from Georgia clay; clay aggregate #4, and clay brick aggregate, the latter two from the Pittsburg Branch of the Bureau; brick from Augusta, Georgia, and Macon, Georgia; pumice stone; volcanic rock from New Mexico; coke breeze; and silica slag.

Various sizes of "Cinch" anchor bolts have been tested for determining their value for attaching materials and machinery to concrete and they were found to be satisfactory. An extensive series of tests is being conducted on the placing of concrete by means of the cement gun, including the determination of the value of different mixtures and the effect of the different methods of operation, results being compared with material produced by pouring in the usual manner.

3 Airplane Fabrics. Investigation made of failures of cotton and linen airplane fabrics in service, during the progress of which exhaustive tests were made, have led to the conclusion that the fabrics in question had in no wise deteriorated and that the failure was the result of utilization of a fabric whose strength and construction were not adapted to the new type of plane,- on which it was exposed to stresses and vibration of greater amount than had been encountered before. However, in order to supply a fabric for the plane as constructed, a new material of greater strength and weight was developed by experimental manufacture at the mill, under the supervision of a representative of the Bureau. A satisfactory product was secured and is now under manufacture.

4 Balloon Fabrics. The recently installed micro-photographic laboratory for the textile and paper sections is now in operation and interesting results are being obtained on a field to which microscopy has been applied in but a limited way. Cross sections of rubber-

ized balloon fabrics when examined, showed in part the reasons for the high permeability of the rubber films, since in some cases crystallizing out of the sulfur could be noted and in others the filling material was not advantageously distributed.

5 Other Textile Investigations. Heat conduction measurements have been made on a number of fabrics constructed of combinations of several wools and hairs, in relation to the utilization of such materials for uniforms under the Quartermaster Corps. At the request of the War Industries Board an investigation is in progress to determine the best method of packing commodities for the retail dry-goods and clothing business in order to conserve paper and car space in shipping. The results obtained are of surprising value and interest. The Bureau has cooperated with the Ordnance Department in the design of parachute fabrics for bombing lights.

6 Electro-welding of Ship Plates. Two members of the staff attended a meeting of the Electric Welding Committee of the Emergency Fleet Corporation on July 16, in connection with the possibility of replacing riveting by welding processes, for ship construction. Eight sets of test specimens welded by different manufacturers have been sent to the Bureau for investigation. Tensile and cold bend tests so far made show strength greater than that of the riveted joints commonly used for ship construction and the specimens exhibited considerable ductility as well. In order to insure uniformity, all of the testing will be carried on under the immediate supervision of this Bureau. A rectangular steel tank made by the General Electric Company at Pittsfield, Massachusetts, and comprising in its construction many of the types of welds considered as of possible utility for use in ships, will be subjected to repeated applications of pressure both internal and external,- which will give valuable information on the behavior of such joints as regards endurance under repeated loading. The electro-welding of ships is an important problem since it offers opportunity for considerable saving in production costs.

7 Testing of Airplane Beams. Work is being carried on in the construction of a special apparatus for testing airplane beams. The specimens used will be full length beams exactly similar to those employed in actual construction. They will be subjected to loading identical in amount and distribution to that specified in the stress diagram, enabling the most accurate information

regarding the performance of the beams to be secured. The necessity for the investigation arises from the fact that beams of different construction or material which may have exhibited the same strength when loaded as simple beams have shown quite different properties under the more complex combined bending and axial loading to which they are subjected in service. This method of testing will permit the complete determination of the static strength of any proposed construction in the laboratory and will eliminate the necessity of flying tests on any but the most promising types of construction.

8 Aeronautic Power Plant Investigations. The major portion of the program of work in the altitude laboratory carried on in cooperation with the National Advisory Committee for Aeronautics and the Bureau of Aircraft Production and relating to the effects of various fuels on airplane engines at different speeds and altitudes, has been completed. A special series of tests on the new model Hispano Suiza engine was completed for the Bureau of Aircraft Production. Reports are in preparation on the following subjects, for which substantially all the experimental data have been obtained: (1) complete description of the construction and operation of the altitude laboratory; (2) analysis of the results of certain fuel tests run at a single engine speed; (3) analysis of results of fuel tests indicating effect of fuels at varying engine speeds with practicable carburetor adjustments; (4) analysis of results of fuel tests with the best possible carburetor adjustments; (5) comparison of a number of carburetor designs already tested; (6) effect of temperature of intake air on engine power, by direct observation. (These results differ by 30 to 40 percent from the theoretical corrections usually assumed.); (7) experiments on the effect of exhaust back pressure on engine power; (8) a brief analysis of the effect of altitude on engine power; (9) experiments on the effect of varying the amount of super-charge up to full atmospheric pressure for altitudes to 20,000 feet; (10) preliminary report on the effect of compression ratio on power output at all altitudes.

The demands for experimental work in the altitude laboratory now exceed the present capacity of the plant and consideration is being given to the enlargement of the facilities to care for the increased work. Problems requiring investigation include special tests of fighting gasoline, with respect to the specifications for this material; special tests of

the 300 h.p. Hispano Suiza engine preparatory to putting that engine into production; study of the effects of compression ratio and of special fuels and various altitudes, as related to the phenomenon of engine knock, and to the utilization of higher compression ratios; an investigation of carburetor performance at high altitudes with the development if possible, of a satisfactory compensative carburetor for the purpose; and a number of other questions of the greatest importance.

Experimental engine tests which included extended runs with graphite lubricants, have shown very satisfactory behavior, and no objections to the use of this material have yet developed.

9 Aeronautic Instruments. Investigation was made to determine, if possible, whether or not certain airplane thermometers underwent appreciable alteration of calibration characteristics in shipment. A retest of a number of such thermometers, previously compared with standards at the factory, led to the conclusion that no appreciable change is to be expected.

10 Steel in Aircraft Construction. A set of metal wings manufactured by the Empire Art Metal Company for the National Advisory Committee for Aeronautics and under the supervision of the Bureau of Standards, were tested in flight by the Airplane Engineering Department at McCook Field. On subsequent inspection after flight of nearly 60 hours no deterioration was found. These wings were then subjected to a static sand load test and exhibited a factor of 5 times the normal flying load. A second set of wings, duplicates of those which had been flown, were also tested and found to possess a factor of $5\frac{1}{2}$. The difference in the strength of these two wings is not sufficient to prove that the first had detericrated in flight. A set of wood wings have also been tested for comparison and found to have a factor of $6\frac{1}{2}$.

11 Other Aeronautic Investigations. An investigation is being made of the design of a variable camber wing looking to the determination of (1) shapes taken in intermediate positions, (2) behavior under overloads, (3) weight as compared with standard construction. Tests of a full length, built-up wood wing beam designed for the H.S.I. Curtiss flying boat show that the built-up beam was equal in strength to the solid beam, verifying previous determinations along the same line. A final report on the built-up types has been submitted in which the advantages of built-up constructions were made evident. The great saving of wood

effected by the use of this type of construction makes the matter one of importance. The study of the behavior of aluminum tubing under repeated stress has been started.

Samples of wood covered with a protective coating of copper proposed for airplane propeller construction were found to be unsatisfactory because of the great increase in weight without appreciable increase in strength.

Vulcanized fibre was subjected to gun fire and to bending tests, but the material was found to offer no advantages in resisting gun fire and its strength compared with airplane woods did not compensate for its greater weight.

12 Miscellaneous Tests of Strength of Materials. Tests of 3 types of powder containers, including determinations of strength and water-tightness showed the asphaltum-impregnated containers to be satisfactory while this was not true of the paraffin-impregnated containers. An investigation was made of the possibility of utilizing rope made of a lower grade of fibres than those called for in the Government specifications, but it was found that the requisite strength was not attained by rope of the substitute materials.

Various materials subjected to physical tests included calibration bars for checking of testing machines, patented snaps for holding aviators to gun scarf mounts, aluminum alloy castings, stranded wire cable, steel tire base band, scythe blades, lifting jacks, galvanized chains, welded adapters and booster casings for gas shells, tinned aviator wire, waterproof veneers, scissors, trench knives, and brass cartridge cases.

13 Master Plates for Mil Scales. Two new masterplates have been engraved for the Optical Shop Annex, U.S. Naval Gun Factory. These plates bear the latest range values, both metric and English, and are used as pantograph controls in tracing the mil scale of the type EE field glass. Additional plates have been made from the first by an electrotype process so that the Bureau can now supply any number on very short notice. This Bureau also developed a filler for the fine etched lines appearing on the mil scale, this filler being easily applied and absolutely permanent.

14 Direct Reading Micrometer Gage. A new design of continuous thickness gage has been constructed for the Field Medical Supply Depot. The gage was originally designed for testing the diameter of the suture material used in sewing up wounds but is now being used for many purposes. The material to be tested is passed under a roller which supports the spindle of an Ames Dial Indicator. The in-

strument, after adjustments with Johansson blocks, was found to be accurate to better than 10 microns, (($\frac{1}{2500}$ inch). Variations in thickness and absolute values as well, may be observed as the material passes continuously through the instrument.

15 Range Scales Corrected. The error which was appearing in the range divisions of the mil scale of many type EE field glasses has been corrected. The error was discovered in February, 1918, a few days after the first sample, together with specification 263-L, had been delivered to the Bureau. This was immediately reported to the Chief Signal Officer of the Army, also to the firm supplying these glasses.

Respectfully,

S. W. STRATTON

Director